Presented by; Ann-Sophie Hamel-Boisvert,ing jr

Carnot Refrigeration.

Air Conditioning Possibilities with Transcritical CO_2

November 18th 2017

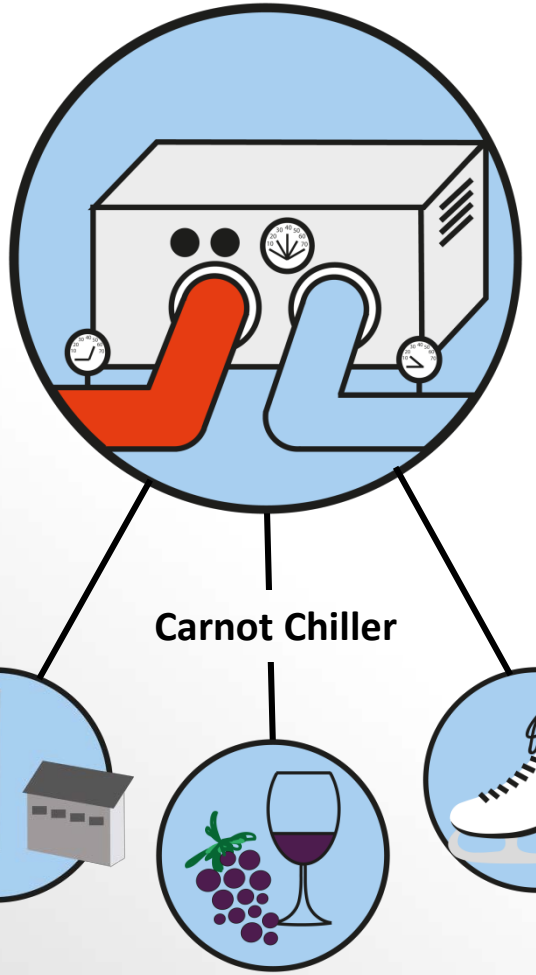
Montreal, CANADA

CARNOT REFRIGERATION

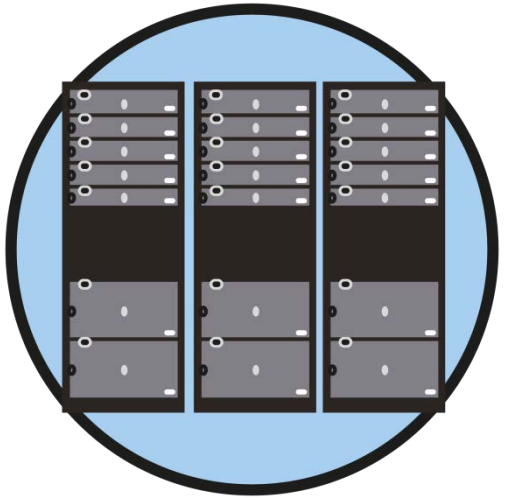
Carnot Refrigeration

Carnot Supermarket

Carnot Warehouse



Carnot Chiller



Aquilon™ Data Center

« See the possible where the others see the impossible »

Carnotrefrigeration.com
3368, Bellefeuille Street, Trois-Rivieres, QC G9A 3Z3 – Phone : 819 376-5958

https://www.youtube.com/watch?v=mMFkChrQeh8

CARNOT REFRIGERATION

R-744 in Air Conditioning

- Possibility of Free-Cooling
  - What is the cooling demand during the cooler months?
- Heat Recovery Demand
  - Is there a need for heating and cooling simultaneously?

CARNOT REFRIGERATION

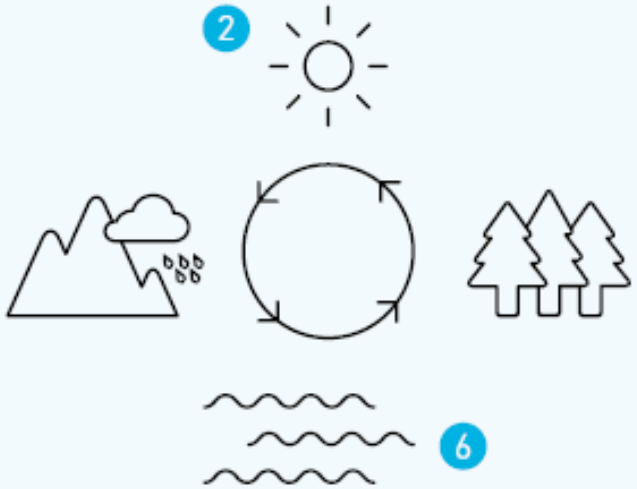
Data Center Air Conditioning
Since 2013, R-22 replacement

- Constant cooling demands year long
- Space Restrictions
  - Smaller Footprint
  - Smaller Piping
- Installation Restrictions
  - Orbital Welding

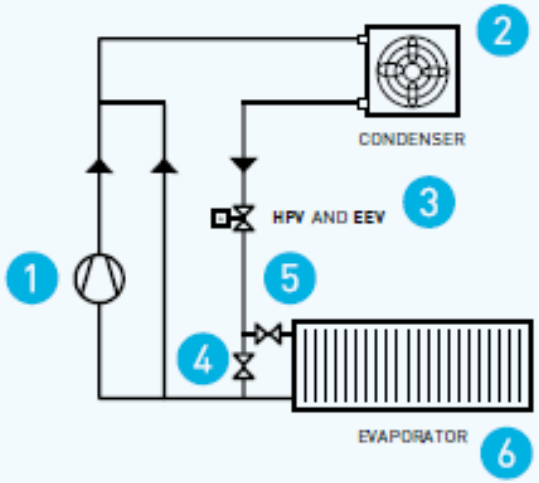
CARNOT
REFRIGERATION

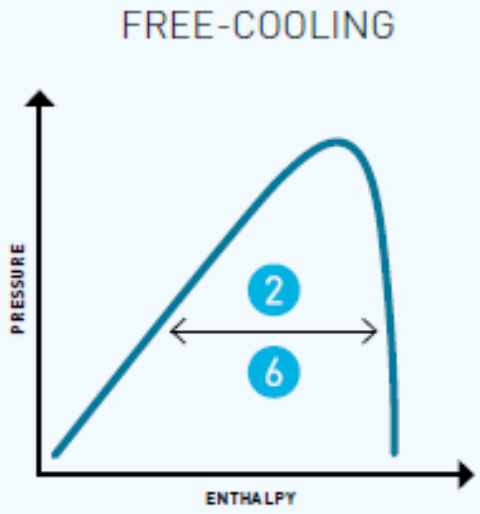
« Simplicity is the ultimate sophistication…. »
– Leonardo da Vinci

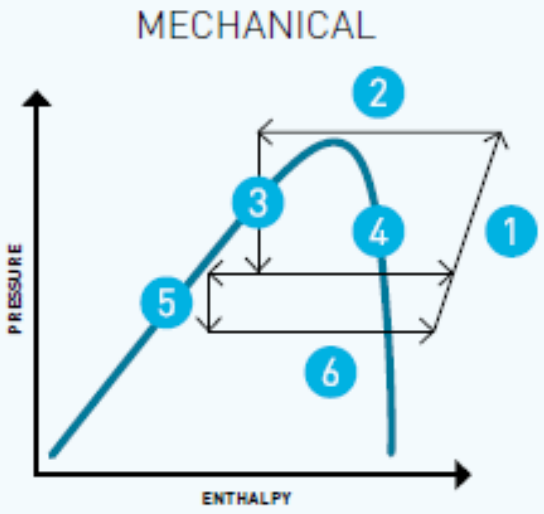
NATURAL
RAIN CYCLE



PATENTED RAIN CYCLE
FREE COOLING IN PH DIAGRAM

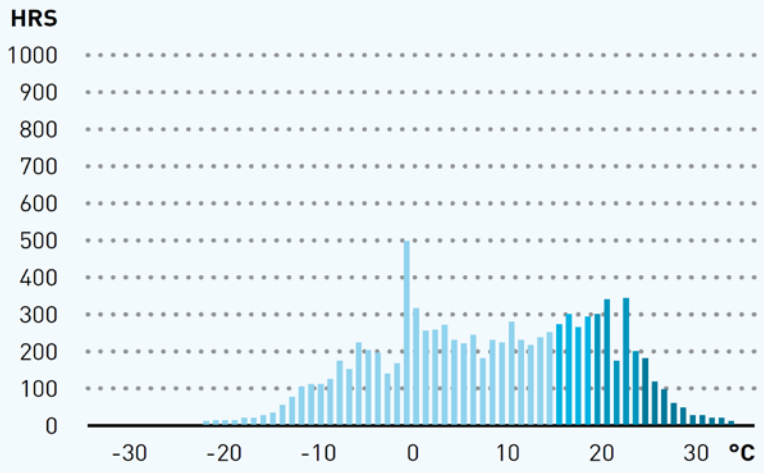




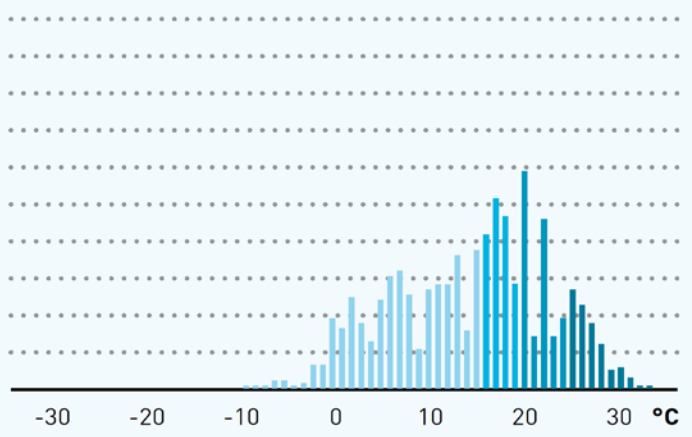


CARNOT
REFRIGERATION

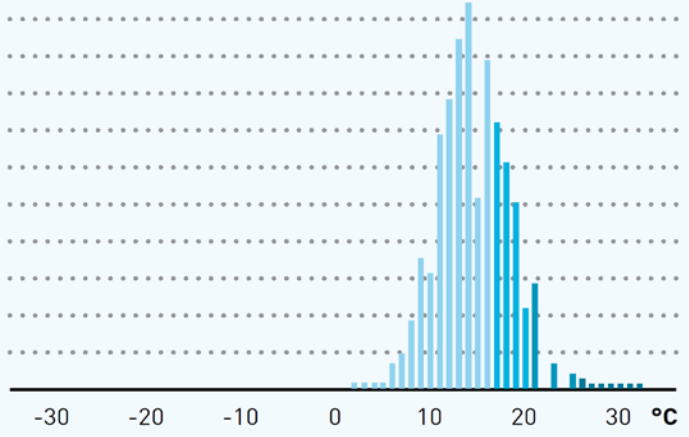
Bin Hour Analysis: Rain Cycle Free-Cooling™



MONTRÉAL



NEW YORK

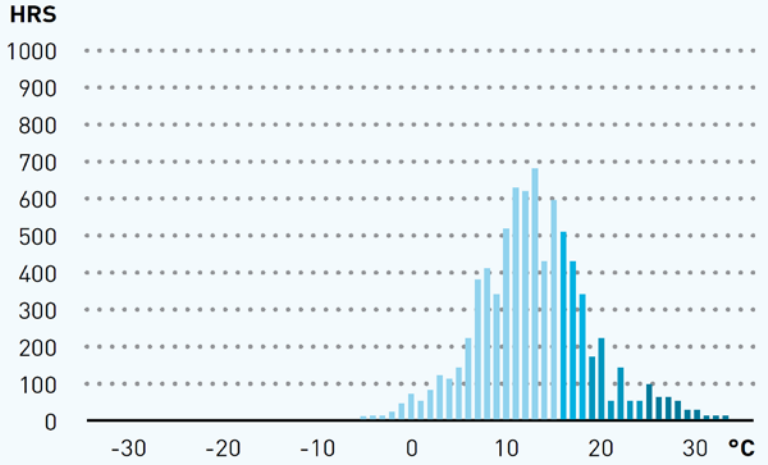


SAN FRANCISCO

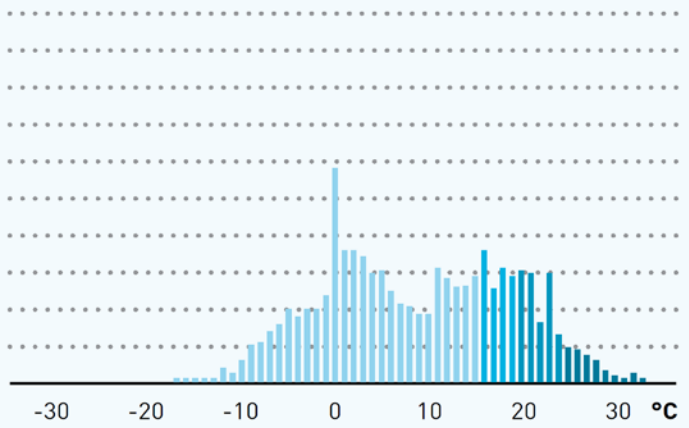
FREE COOLING OPERATION
MECHANICAL MODULATION
SUBCRITICAL OPERATION
TRANSCRITICAL OPERATION

kW [kW] TOTAL POWER CONSUMPTION FOR 80% LOAD
pPUE POWER UTILISATION EFFECTIVENESS

Notes: Data for *Aquilon-15 17.2 TR (60.5 kW)*, model shown above, based on fluid temperature of 75°F (24°C) and outdoor temperature of 95°F (35°C). Data for models *Aquilon-50 50 TR (175 kW)* and *Aquilon-30 30 TR (100 kW)* also available upon request.



SEATTLE



TORONTO

Typical Chiller Information
40TR (12.8°C *(55°F)* – 7.2°C *(45°F)*)

Outdoor Air Temperature	Compressor COP	Total COP
32°C *(90°F)*	2.9	2.6
28°C *(88°F)*	3.6	3.2
24°C *(75°F)*	4.4	3.8
20°C *(68°F)*	4.8	4.1
16°C *(61°F)*	5.1	4.5
12°C *(54°F)*	5.4	4.7
8°C *(46°F)*	5.7	5.0
4°C *(39°F)*	No Compressor	26
0°C (32°F)	No Compressor	29

CARNOT REFRIGERATION

Typical DX System Information 40TR (24°C *(75 ° F)*-12°C *(54°F)*)

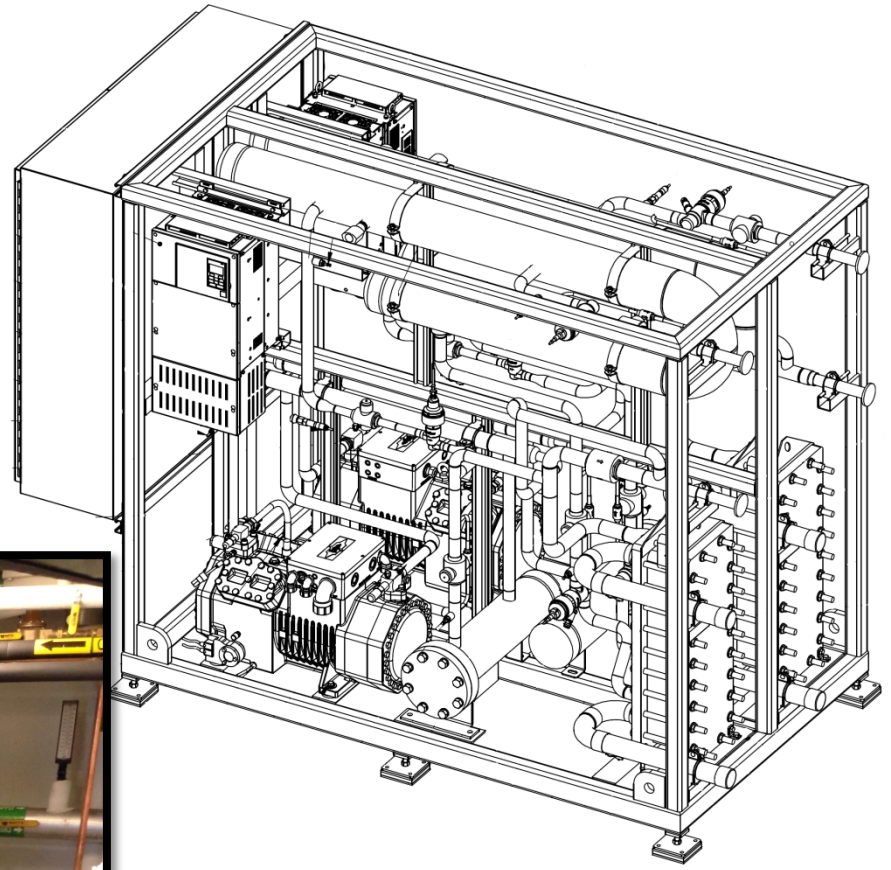
Outdoor Air Temperature	Compressor COP	System COP
32°C *(90°F)*	3.0	2.7
28°C *(88°F)*	3.8	3.3
24°C *(75°F)*	4.6	4.0
20°C *(68°F)*	5.0	4.3
16°C *(61°F)*	5.4	4.7
12°C *(54°F)*	5.7	4.9
8°C (46°F)	***No Compressor***	***26***
4°C *(39°F)*	No Compressor	27
0°C *(32°F)*	No Compressor	29

CARNOT REFRIGERATION

Example Project

Air Conditioning with a CO2 System

- *German Embassy, Ottawa, Canada, 2017*



CARNOT REFRIGERATION

Reducing the Peak Load

- Dry Cooler vs Adiabatic Gas Cooler
- Dry Bulb Temperature vs Wet Buld Temperature

CARNOT REFRIGERATION

Typical Chiller Information
40TR (12.8°C *(55°F)* – 7.2°C *(45°F)*)

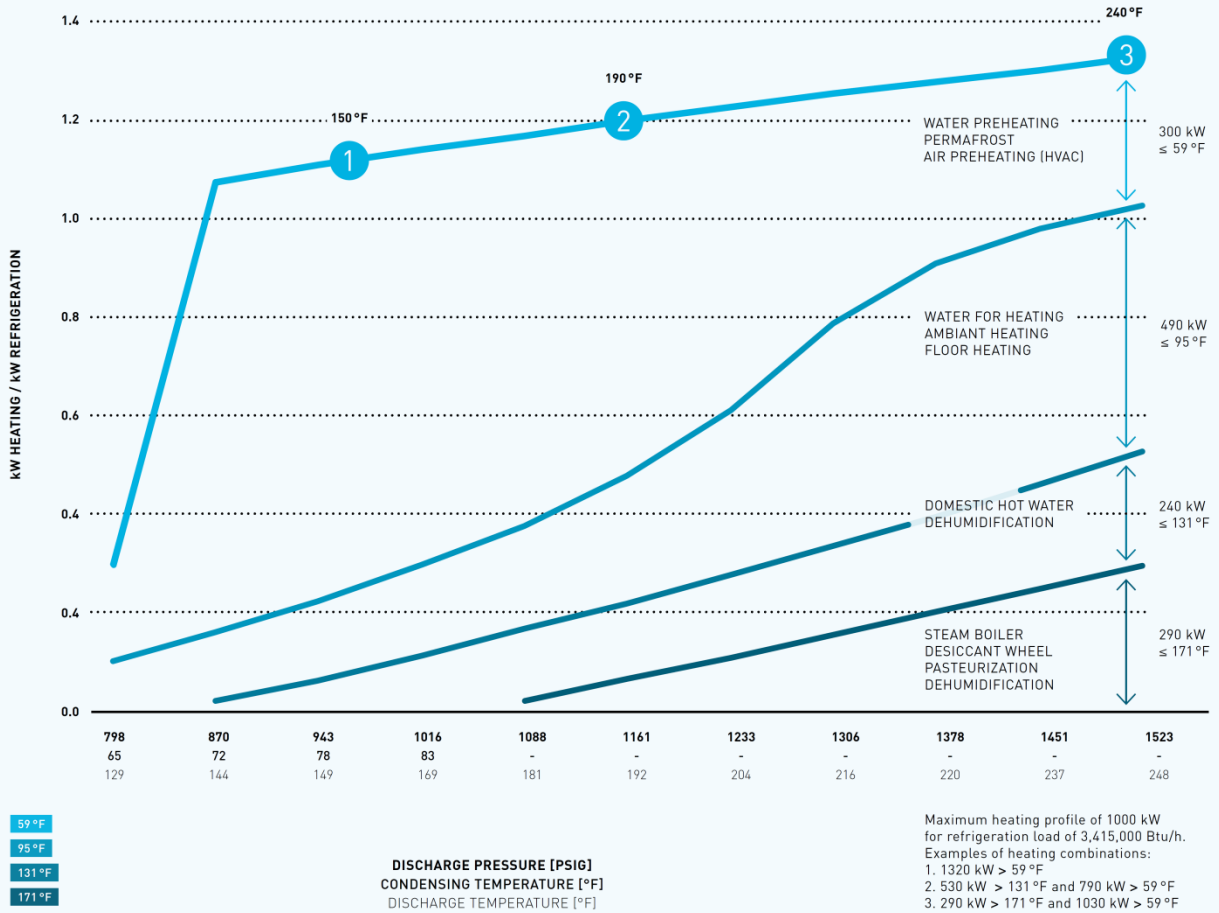
Outdoor Air Temperature	Compressor COP	Total COP
32°C *(90°F)*	2.9	2.6
28°C *(88°F)*	3.6	3.2
24°C *(75°F)*	4.4	3.8
20°C *(68°F)*	4.8	4.1
16°C *(61°F)*	5.1	4.5
12°C *(54°F)*	5.4	4.7
8°C *(46°F)*	5.7	5.0
4°C *(39°F)*	No Compressor	26
0°C (32°F)	No Compressor	29

CARNOT REFRIGERATION

CO_2 ADVANTAGES : Heat Recovery

RCINTELLIGENT IS A SMARTER WAY TO USE THE REJECTED ENERGY OF YOUR PROCESS.

HEAT RECOVERY AVAILABLE WITH
CARNOT CO_2 TRANSCRITICAL SYSTEMS



CARNOT REFRIGERATION

Typical Chiller Information
Cooling Load 130 kW (12.8ºC *(55ºF)* – 7.2ºC *(45ºF)*)
Heating Load 110 kW (29.5 ºC(85 º F) - 35 ºC (95 º F))

Outdoor Air Temperature	Cooling COP	Combined COP
32ºC *(90ºF)*	2.5	5
28ºC *(88ºF)*	3.3	6
24ºC *(75ºF)*	3.5	6.4
20ºC *(68ºF)*	3.7	6.8
16ºC *(61ºF)*	3.9	7.2
12ºC *(54ºF)*	4.1	7.6
8ºC *(46ºF)*	4.3	7.9
4ºC *(39ºF)*	4.5	8.2
0ºC (32ºF)		29

CARNOT REFRIGERATION

Thank you

CARNOT
REFRIGERATION